FIXED-UFM Ultrasonic Flowmeter - Modbus RTU Slave Module

Operating Instructions

Version 1.0

24th October 2020

Contents

1.0 Introduction

- 1.1 Mode
- 1.2 Baud rate
- 1.3 Parity
- 1.4 Stop Bits
- 1.5 Modbus Address
- 1.6 Data bits
- 1.7 Register format
- 1.8 Representation of floating-point values

2.0 Modbus Commands

- 2.1 Read Holding Registers 03
- 2.2 Read Input Registers 04
- 2.3 Write Single Register 06

3.0 Broadcast address

Appendix 1: Communication Command Structure
Appendix 2: UFM Register Map

1.0 Introduction

Modbus Slave functionality is implemented in the Sonic Driver ™ range of Fixed UFM clamp-on ultrasonic flowmeters by means of an optional plug-in board.

Modbus settings are fully configurable on the UFM using its Human Machine Interface (HMI).

1.1 Mode

The Modbus RTU protocol is implemented over RS485 hardware.

Physical connection to the 2-wire bus is via the screw terminals on the end of the plug-in board. The terminals are labelled 'A' and 'B'.

Note that some equipment manufacturers label their terminals in other ways, e.g. ‘+’ and ‘-‘ so the exact order that the wires are connected may be reversed.

There is also a screw terminal for connection of cable screen. This may be connected at the Master or Slave UFM if necessary.

1.2 Baud rate

The RS485 baud rate can be selected using the HMI on the UFM;

- 9600 **(Default)**
- 19200

1.3 Parity

The RS485 parity can be selected using the HMI on the UFM;

- None **(Default)**
- Even
- Odd

1.4 Stop Bits

The RS485 stop bits can be selected using the HMI on the UFM;

- 1 **(Default)**
- 2

1.5 Modbus Address

The Modbus plug-in board Slave address is programmable using the HMI on the UFM, from 1 to 247.

The default Slave address is set to **1**.

1.6 Data bits

RS485 serial data is fixed at **8 bit**.

1.7 Register format

In the Modbus plug-in board each Modbus register is a 16-bit word, consisting of two 8-bit bytes.

Register data in Modbus messages are packed as 2 bytes per register. The binary contents are right justified in each byte. For each register the first byte contains the high order bits and the second byte contains the low order bits.

A floating-point number is stored as 32 bits using 4 bytes and therefore occupies 2 Modbus registers.

1.8 Representation of floating-point values

The micro controller on the Modbus plug-in board stores floating point values in IEEE 754 single precision format.

The bus Master accesses a floating-point value from any one of 4 different register tables. Each register table represents a different byte order.

Table start	Byte order	Common Description
0x0000	1,0,3,2	Floating-point Little-Endian with byte swap **(Default)**
0x1000	0,1,2,3	Floating-point Little-Endian Format
0x2000	3,2,1,0	Floating-point Big-Endian Format
0x3000	2,3,0,1	Floating point Big-Endian with byte swap

By reading the first register of each table the user can determine which format matches their system when a fixed test value of **1234.0** is received.

2.0 Modbus Commands

The Modbus plug-board implements Modbus commands 03, 04 and 06.

2.1 Read Holding Registers 03

This function code is used to read from 1 to 52 contiguous holding registers from the UFM. Registers are addressed starting at zero. Therefore holding registers numbered 1-32 are addressed as 0-31.

The Modbus Master specifies a start address and register count.

2.2 Read Input Registers 04

This function code is used to read from 1 to 52 contiguous input registers from the flowmeter. Registers are addressed starting at zero. Therefore input registers numbered 1-32 are addressed as 0-31.

The Modbus Master specifies a start address and register count.

2.3 Write Single Register 06

This function code is used to write a single register. This function code is used to reset the Slave UFM internal totals from the Master.

The Master specifies an address and 16-bit data value for write.

The value is an unsigned 16-bit value. Valid values are in the range 1 to 3 inclusive.

Writing a value of 1 to register 60300 will clear the unit's internal flow metering totals.

Writing a value of 2 to register 60300 will clear the unit's internal energy metering totals.

Writing a value of 3 to register 60300 will clear both the unit's internal flow and energy metering totals.

3.0 Broadcast address

The Modbus plug-board supports broadcast address **0**.

In broadcast address mode the Modbus master can send a command to all slaves.

No response is sent by the slaves.

Appendix 1: Communication Command Structure

Read holding registers command		
	Slave ID	(1 byte)
	Function	(1 byte=03H)
	Start Address	(2 bytes)
	No. of Registers R	(2 bytes)
	CRC code	(2 bytes)
Response		
	Slave ID	(1 byte)
	Function	(1 byte)
	Byte Count N	(1 byte)
	Hex Data	(N bytes)
	CRC code	(2 bytes)
Note N = R x 2		
Read input registers command		
	Slave ID	(1 byte)
	Function	(1 byte=04H)
	Start Address	(2 bytes)
	No. of Registers R	(2 bytes)
	CRC code	(2 bytes)
Response		
	Slave ID	(1 byte)
	Function	(1 byte)
	Byte Count N	(1 byte)
	Hex Data	(N bytes)
	CRC code	(2 bytes)
Note N = R x 2		
Write single register command	Slave ID	(1 byte)
	Function	(1 byte=06H)
	Start Address	(2 bytes)
	Hex Data	(2 bytes)
	CRC code	(2 bytes)

Appendix 2: UFM Register Map

Modbus Address	Measurement Variable	Bytes	Format
40001	Fixed test pattern 1234.0	4	IEEE
40002			
40003	Flow Velocity (m/s)	4	IEEE
40004			
40005	Flow Rate	4	IEEE
40006			
40007	Flow Positive Total	4	IEEE
40008			
40009	Flow Negative Total	4	IEEE
40010			
40011	Flow Net Total	4	IEEE
40012			
40013	Energy Rate	4	IEEE
40014			
40015	Energy Positive Total	4	IEEE
40016			
40017	Energy Negative Total	4	IEEE
40018			
40019	Energy Net Total	4	IEEE
40020			
40021	Delta Time Difference (ns)	4	IEEE
40022			
40023	Upstream Transit Time (us)	4	IEEE
40024			
40025	Signal Amplitude (dB)	4	IEEE
40026			
40027	Signal Noise (dB)	4	IEEE
40028			
40029	Amplifier gain (dB)	4	IEEE

40030			
40031	ETA/ATA (%)	4	IEEE
40032			
40033	Signal Diagnostic 1 (us)	4	IEEE
40034			
40035	Signal Diagnostic 2 (ADU)	4	IEEE
40036			
40037	Signal Diagnostic 3 (ADU)	4	IEEE
40038			
40039	CU Temperature (degC)	4	IEEE
40040			
40041	Inlet Temperature (degC)	4	IEEE
40042			
40043	Outlet Temperature (degC)	4	IEEE
40044			
40045	Fluid Temperature (degC)	4	IEEE
40046			
40047	Pipe Internal Area (m2)	4	IEEE
40048			
40049	Fluid Density (kg/m3)	4	IEEE
40050			
40051	Fluid Specific Heat Capacity (J/K.degC)	4	IEEE